EXHIBIT 1

WRITTEN TESTIMONY OF JONATHAN ROSENFIELD, Ph.D., CONSERVATION BIOLOGIST, THE BAY INSTITUTE

REGARDING A PETITION FOR TEMPORARY URGENCY CHANGE FILED BY THE DEPARTMENT OF WATER RESOURCES (DWR) AND THE U.S. BUREAU OF RECLAMATION (USBR) REGARDING TEMPORARY RELAXATION OF THE FEBRUARY DELTA OUTFLOW AND THE SAN JOAQUIN RIVER FLOW OBJECTIVES IN RESPONSE TO CURRENT DRY CONDITIONS

SUBMITTED TO
THE STATE WATER RESOURCES CONTROL BOARD
FEBRUARY 17, 2009

My name is Jonathan Alan Rosenfield. I am employed by The Bay Institute of San Francisco where my title is Conservation Biologist. I earned a Bachelor's of Science in Natural Resource Ecology from Cornell University in 1991. In 1996, I earned a Master's of Science in Conservation Biology and Environmental Management from the University of Michigan's School of Natural Resources and Environment. I earned a Ph.D. in Biology from the University of New Mexico in 2001. There, my focus was on the ecology, evolution, and behavior of fish species.

I have authored or co-authored several peer-reviewed scientific papers on the ecology, evolution, and behavior of fish species. In 2007, I published results of my post-doctoral research regarding the population dynamics and distribution patterns of longfin smelt in the San Francisco Estuary. I have also worked as a biological consultant to California and federal agencies on projects that assessed the current state of the San Francisco Estuary ecosystem and the likely response of this ecosystem to perturbations and restoration activities. My qualifications are fully described in Exhibit 2.

I have reviewed the Petition submitted by DWR and USBR for a Temporary Urgency Change (TUC) to temporarily relax three requirements of Water Right Decision 1641. The stated purpose of this change is to reduce freshwater flow from the Delta in order to allow DWR and USBR to retain more storage in their upstream reservoirs. I have reached the following findings regarding this petition.

1) <u>The Petition neglects to estimate and incorrectly dismisses the negative impacts to estuarine and migratory species of reducing Delta outflow during the winter</u>. The reduction in Delta outflow proposed in the Petition will likely have a negative effect on the estuarine species for which a significant relationship between flow and abundance has been documented – it is also possible that reductions in Delta outflow flow will have a negative impact on species for which the population response to flow has not been studied. For some species, the negative

effects of decreased outflow will be exacerbated if export pumping in the Delta increases over the minimum necessary to maintain human health and safety (*see below*). I want to emphasize that several of the species that will experience these negative impacts are in danger of extirpation in the very near future – any operational changes that increase mortality or decrease productivity for these species increases their risk of extirpation and should be avoided to the maximum extent possible.

Well-established empirical relationships between freshwater flow and abundance of several estuarine species strongly suggest that the proposed relaxation of Delta outflow objectives will harm populations of estuarine and migratory fish and prey populations in the Delta. The petitioners' claim that reductions in flow will not cause quantifiable reductions in fish populations because, in part, "relatively small changes in lower flows are not significant to abundance", reflects a misunderstanding of the nature of these relationships. The Petition also significantly understates the magnitude of the proposed Delta outflow reductions because Delta outflow objectives in each of the months during the February through June period are based on antecedent hydrological conditions. Thus, if Delta outflow requirements for February are relaxed, conditions will be established that increase the likelihood of reduced Delta outflows in March and subsequent months. This is no small change in the freshwater flow prospects for the Delta this year. Although time constraints prevent me from calculating the potential impacts of the proposed changes in Delta outflow to the numerous estuarine and migratory species with significant freshwater flow:abundance relationship (*see below*), it is important to note that such impacts could be calculated using the known, well-documented, quantitative freshwater flow (or X_2): abundance relationships found in several recent scientific studies, including Kimmerer et al. (2009) which is attached to the TUC Petition.

The State Board has long recognized the benefits to fish and wildlife populations of freshwater flow into and through the Delta; studies documenting these relationships incorporate data from across four decades (e.g. Stevens and Miller 1983; Jassby et al. 1995; Kimmerer 2002; Rosenfield and Baxter 2007; Kimmerer et al. 2009). The State Board protected fish and wildlife and estuarine habitat beneficial uses by establishing water quality objectives that are well-correlated with abundant populations of aquatic species. In particular, the State Board has relied on the position of the 2ppt isohaline (X_2) as an indicator of the benefits of freshwater flow on fish and wildlife populations. The State Board chose to regulate X_2 from February through June because this metric is strongly correlated with the abundance of so many freshwater and estuarine species (e.g. Jassby et al. 1995; Kimmerer 2002; Kimmerer et al. 2009).

Petitioners appear to suggest that the relationships between freshwater flow (as measured by X_2) and fish abundance no longer exist or are weak (Petition at p14 and 15). This suggestion is at odds with numerous recent studies that document the persistence and strength of the X_2:abundance relationships across a wide range of species; the most recent of these studies (Kimmerer et al 2009) was attached to the TUC petition. The freshwater flow:abundance relationships are usually "log:log" relationships, meaning that population responses are proportional to the order of magnitude of flow increases – these are powerful, high magnitude effects. Although several recent studies have noted "step-changes" (the displacement of the regression line by a constant value) in the freshwater flow:abundance relationships, the statistical significance and slope (magnitude) of the relationship remain unchanged for many of the estuarine species studied (e.g. Kimmerer 2002; Rosenfield and Baxter 2007: Kimmerer et al. 2009). Despite the changes that have occurred in this ecosystem over recent decades (e.g.

following the introduction of numerous invasive species), statistically significant, positive relationships between freshwater flow (measured as inflow, outflow, or X2 position) are still evident for the following fish species:

- Chinook salmon (Newmark and Rice 1997; Brandes and McClain 2001; Baker and Morhardt 2001);
- American shad (Kimmerer 2002; Kimmerer et al. 2009);
- Longfin smelt (Kimmerer 2002; Rosenfield and Baxter 2007; Sommer et al. 2007; Kimmerer et al. 2009)
- Striped bass (*abundance*: Sommer et al 2007; Kimmerer et al. 2009 and *survival*: Kimmerer 2002; Kimmerer et al. 2009)
- Sacramento splittail (Kimmerer 2002, Kimmerer et al. 2009 *and see work by* Sommer and others *reviewed in* Sommer et al. 2008), and
- Starry Flounder (Kimmerer 2002; Kimmerer et al. 2009)

In addition, despite other changes to estuarine processes, relationships that existed in the last century between freshwater flow and abundance of important fish prey species have remained significant, including:

- bay shrimp, *Crangon franciscorum* (Jassby et al. 1995; Kimmerer 2002; Kimmerer 2009) and
- spring populations of *Eurytemora affinis* (Kimmerer 2002).

Two of these recent studies (Rosenfield and Baxter 2007 and Kimmerer et al. 2009) analyzed data from multiple sampling programs and found that the freshwater flow:abundance relationships were present, regardless of the habitat sampled or the methodologies employed.

The petitioners' present an unlabeled, undocumented figure (after page 17 of the Petition) in support of their suggestion that the freshwater flow:abundance relationships are weak; this figure and the associated text reveal misunderstandings regarding the nature of the flow:abundance relationships. First, this figure refers only to longfin smelt populations even though the State Board's mandate includes protection of a wide variety of fish and wildlife beneficial uses. Second, there are several problems with the analysis implied by the figure and its interpretation in the text. The figure is poorly documented (i.e., there is no indication of statistical analysis to support the presentation) and previous studies strongly suggest that the "analysis" presented here is technically flawed in a statistical sense. Rosenfield and Baxter (2007) found that the relationship between Delta outflow and longfin smelt abundance conformed to the assumptions of linear statistics only when both variables where expressed as logarithms. Other authors (e.g., Kimmerer 2002) have analyzed the relationship between log(abundance) and X2 because this relationship also conforms to the assumptions of linear statistics. In each case, the authors rejected analyzing the untransformed population data (as presented in the unlabeled figure) because it produced deviations from the assumptions of linear statistics. Presenting the relationship between untransformed abundance and untransformed Delta outflow as if it were a linear relationship is statistically invalid. In addition, this figure is highly misleading as it does not provide sufficient resolution at the lower end of the range for population and outflow variables. Previous research does not support the Petition's claims that benefits to longfin smelt of increased Delta outflow are not quantifiable at low outflow levels,– log(population abundance) is linearly correlated with log(delta outflow) or X_2 across the range of observed outflow (or X_2) values for numerous species. The implications of this finding are that any increase in winter-spring Delta outflow may produce a benefit to a wide variety of estuarine and migratory species that use the Delta.

Finally, the same relationship (Delta outflow (as measured by X_2 position): longfin smelt abundance (as measured by the Fall Mid-water Trawl)) is analyzed in a paper attached to the Petition (Kimmerer et al. 2009). Kimmerer et al.'s analysis clearly demonstrates that log(longfin smelt abundance) is strongly and positively correlated with freshwater outflow (negatively correlated with X2). Rosenfield and Baxter (2007) presented a similar analysis that supports a linear relationship between log(longfin smelt abundance) and log(freshwater outflow) across a wide range of outflows. Contrary to claims in the Petition, there is no evidence that this relationship does not hold at lower outflows.

The vast majority of the research on the relationship between freshwater flow and fish and wildlife population abundance in this estuary points to a clear conclusion: freshwater flow has a powerful, significant, consistent, and widespread positive effect on productivity of many fish species and their prey. Although, in some cases, the relationships between freshwater flow and abundance in the last two decades have a different intercept than they did prior to the late 1980's (i.e. a step-change has occurred), the fundamental relationships (their slope and significance) remain largely unchanged. Thus, petitioners' claim that relaxed Delta water quality standards will not have deleterious effects upon fish, wildlife or other beneficial uses is unsupported.

There is no mystery to estimating the negative impacts to estuarine and migratory species that will result from the reduced Delta outflows proposed in the petition. As noted above, and contrary to the Petition's claim, the negative impacts of reduced Delta outflow are quantifiable using relationships documented in peer-reviewed publications. There is no technical reason why the petitioners could not or should not have produced a quantitative estimate of these impacts.

2) The Petition's claim that the Delta outflow objective is premised on a supposed relationship between the position of X2 and habitat volume is erroneous, as is the assumption that such a relationship has been invalidated. DWR and USBR argue (Petition, pp. 12-13) that the X_2 standard is based on a single mechanism – that lower values for X_2 (greater Delta outflow) produce greater volumes of habitat for fish and wildlife species. I am not aware of any peer-reviewed scientific publication that claims such a mechanism is the only (or even the leading) hypothesis to account for clear empirical relationship between freshwater flow and populations of numerous estuarine species.

There are multiple potential mechanisms that may drive the relationship between freshwater flow through the Estuary and population response of numerous fish and wildlife species. The number of significant freshwater flow:abundance relationships (i.e. the number of species involved) strongly suggest that the correlations reflect a causal mechanism or suite of mechanisms that increase fish production as a result of increases in freshwater flow. The breadth, strength and persistence of these relationships justify the search for these causal mechanisms. Kimmerer (2002b) identifies 11 potential mechanisms and their may be others that have yet to be identified. The mechanisms driving the freshwater flow:abundance relationships are almost certain to vary by species and life stage.

The petitioners' interpretation of new research by Kimmerer et al (2009) as undermining the validity of the freshwater flow:abundance relationship is flawed in at least two ways. First, the X_2 standards are not based on any particular mechanistic explanation of the freshwater flow:abundance relationships**.** The requirements to maintain Delta outflows are based on the strong relationships between freshwater flow (as represented by X_2) and fish and wildlife populations. Jassby et al. (1995) documented many of the strong correlations between abundance and Delta outflow, and concluded:

> "[X_2] has simple and significant statistical relationships with annual measures of many estuarine resources, including the supply of phytoplankton and phytoplankton-derived detritus …; benthic macroinvertebrates …; mysids and shrimp; larval fish survival; and the abundance of planktivorous, piscivorous, and bottom-foraging fish. *The actual mechanisms are understood for only a few of these populations*." (Jassby et al 1995:272; *emphasis added*).

Kimmerer (2002b, 2004) provided excellent reviews of the complexity of the estuarine ecosystem and the potential for a variety of mechanisms to impact fish and wildlife resources that the State Water Board has a responsibility to protect. Thus, invalidating a relationship between freshwater flow and habitat volume or a relationship between habitat volume and population response does not undermine either the fundamental relationship between freshwater flow and fish species abundance or the validity of other mechanisms that may cause this relationship

Second, the paper by Kimmerer et al (2009) actually demonstrates that X_2:habitat volume relationships are significant for several species (Kimmerer et al, Fig. 9). The freshwater outflow:habitat volume relationships for American shad and striped bass are consistent with their population response to freshwater flow – in other words, the relationship of freshwater flow to habitat volume may be a strong driving force for the population responses of these two species. For several other species (e.g. longfin smelt), the relationship between X_2 position and habitat volume may explain a small portion of the population response to increasing freshwater flow. Far from disproving or "weakening" the relationship between freshwater flow and population abundance for these species, the authors conclude that "other mechanisms are likely operating to cause these species [other than striped bass and American shad] to increase in abundance with increasing flow" (Kimmerer et al. 2009: p. 7).

3) <u>Relaxation of the San Joaquin River flow objectives will also negatively impact estuarine species and habitat in the Delta</u>. The petitioners' request to relax these objectives is solely based on the structure of the regulatory requirement for these flows – in other words, the requirement to maintain higher San Joaquin River inflow to the Delta is linked to the requirement to comply with the higher Delta outflow objective. The Petition neither provides a biological justification for reducing San Joaquin River flows nor addresses potential impacts of doing so.

Populations of Chinook salmon that migrate, hold, spawn, or incubate during the summer (i.e. winter run, spring run, and late-fall run) and would presumably benefit from reduced releases to maintain the cold water pool in upstream storage facilities in the Sacramento River Basin do not spawn in the San Joaquin River or its tributaries. Populations of Chinook salmon that do spawn in the San Joaquin River basin will not benefit from maintenance of the cold water pool in the Sacramento Basin. The Petition offers no rationale and describes no intention of using additional water stored in the San Joaquin Basin as a result of this Petition for the benefit of fish and wildlife in the Delta, the San Joaquin River, or its tributaries..

Reduction of winter-spring flows in the San Joaquin River will negatively impact survival of fall run Chinook salmon migrating in that River. Fall run Chinook salmon spawn in the tributaries of the San Joaquin and the peak of juvenile outmigration occurs during February and March (Moyle 2002; Williams 2006). Particle tracking results indicate that reducing San Joaquin River flow can reduce the rate and success of juvenile salmon migration through inhospitable parts of the southern Delta and increase their susceptibility to export-related entrainment (Kimmerer and Nobriga 2008). In a presentation to the State Board, Marston and Hubbard (2008) presented evidence of "[e]mpirical positive relationship of average spring flow and the estimated number of … smolts that pass Mossdale per fish that spawned" and "[e]mpirical positive relationship of concurrent Mossdale flow and survival of smolts from Mossdale to Chipps [i.e. through the Delta] from release-capture experiments". Similarly, Baker and Morhardt (2001) found a correlation between San Joaquin River flows and the subsequent return of spawners from the year class of smolt that experienced those flows.

Reducing inflow from the San Joaquin River may lead to increased entrainment of other species (e.g. longfin smelt) at the South Delta water export facilities. Negative ("reverse") flows in the San Joaquin River, as measured by Old and Middle River flows (OMR), are associated with high entrainment of several species, including Delta smelt (Kimmerer 2008). OMR is determined primarily by two factors: San Joaquin outflow and water export rates from the South Delta export facilities. San Joaquin River inflows contribute to currents that move fish (particularly larval fish and migrating Chinook salmon) away from the zone of influence of the export pumps (Kimmerer and Nobriga 2008). Without sufficient flows from the San Joaquin River, currents in the South Delta may be unduly influenced by export operations (even at reduced export rates) causing migrating fish to migrate towards the pumps rather than towards the Bay. In addition to entrainment mortality, reduced net flow towards the Bay probably increases the residence time in the Delta for migrating fish and this may increase their exposure to other sources of mortality (e.g. predatory fish, toxic water quality) present in the Delta

In summary, there is no biological justification offered for decreasing San Joaquin River inflows to the Delta. To the contrary, reduced inflows from the San Joaquin will likely have a negative impact on the successful migration of juvenile San Joaquin fall run Chinook salmon and will increase the likelihood and magnitude of entrainment of other fish in the Delta,.

4) <u>Export pumping by the State and federal water projects is likely to exacerbate the impacts of the proposed relaxation of Delta water quality standards</u>. Water diversions may entrain large numbers of fish – particularly small fish – resulting in increased mortality rates; this is the case at several water diversion facilities in the San Francisco estuary (e.g. Brown et al. 1996). For some species, the relationship between Delta exports and entrainment is at least partially mediated by freshwater flow rates (e.g. Kimmerer 2008; Kimmerer and Nobriga 2008).

In particular, entrainment of longfin smelt juveniles appears to be highest under low Delta outflow conditions (Attachment A). The relationship is statistically significant and independent of total population size (i.e. increased entrainment is not an artifact of a higher population size). This observation matches well with our understanding of longfin smelt life history. Longfin smelt spawn during the winter at or upstream of the interface between fresh and salt water (Baxter 1999; CDFG 2009). In winters where Delta outflow is low and X2 shifts to the east, longfin appear to move further into the Delta to spawn. Thus, when their eggs hatch, a greater proportion of the larvae occur within an area where hydrodynamics are affected by the South Delta export pumps or the North Delta export facilities at Barker Slough. This increases the exposure of larval longfin smelt to entrainment mortality (CDFG 2009). Furthermore, Delta outflow rates are probably highly correlated with larval transport rates and the eventual distribution of juvenile longfin smelt (Baxter 1999) – when net Delta outflows are low, entrainment rates increase substantially at the south Delta pumps[1]. In some years, the proportion of the longfin smelt population lost at the South Delta export facilities may exceed the proportion of the Delta smelt population impacted by export pumping (Kimmerer 2008; Kimmerer *personal communication*) – longfin smelt entrainment at export facilities is proportionately higher during low outflow conditions such as those we are experiencing in 2009.

Failure to restrict export pumping during the period when Delta flow objectives are relaxed (as called for in the Petition) is of particular concern because these two operational changes have a synergistic negative effect on a population that is already precariously close to extirpation. Under the proposed relaxation of Delta water quality standards, the salt field will move to the east and freshwater flow to the Delta will be reduced. These two factors are likely to place larval and juvenile longfin smelt at risk of entrainment and elevated mortality at the pumps. As a result, any relaxation of the Delta outflow standards that occurs without accompanying restrictions on export pumping from the south Delta facilities (for example, to limit the exports that began with the onset of recent rains) will place this year's population of larval and juvenile longfin smelt at great risk of entrainment-related mortality. The population of longfin smelt in the San Francisco Estuary is currently near its lowest point on record and other nearby populations of this species have been extirpated or are extremely small in size (CDFG 2009). Thus, increasing mortality for this species while reducing productivity (by reducing flows) increases the possibility that this longfin smelt population will be extirpated in the near future.

Similarly, export pumping produces entrainment effects on numerous other at-risk species in the Delta. The impacts of entrainment-related mortality on Delta smelt and Chinook salmon have been documented (e.g. Kimmerer 2008). All runs of Sacramento River Chinook salmon are expected to be present in the Delta during the month of February (Moyle 2002; Williams 2006) and thus each run (including the federally and state protected spring and winter runs) are susceptible to entrainment mortality at this time.

I note that, this month, while DWR and USBR were out of compliance with the Delta outflow standards, both agencies increased pumping (presumably to capture freshwater runoff from recent storms). As soon as pumping levels increased, take of Delta smelt, Chinook salmon, and steelhead occurred (Attachment B ; downloaded from the USBR's Central Valley Office website -- http://www.usbr.gov/mp/cvo/) – prior to the increase in pumping rates, no Delta smelt or steelhead had been entrained during the month of February. This example illustrates the risk of increased water exports during periods when Delta outflows are extremely low.

[1] This phenomenon has not occurred this year (entrainment is low) probably because (a) export pumping has been very low during the winter to-date and (b) populations of longfin smelt are near record lows.

5**)** Increasing storage of water upstream now may benefit populations of Chinook salmon and steelhead spawning, incubating, and rearing below state and federal water project reservoirs this summer and fall. The eggs, larvae, and juveniles of Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*) are present below Central Valley dams in the Sacramento River Basin during the summer and fall and each of these life stages is sensitive to high temperatures that may occur below these dams (Myrick and Cech 2004; Richter and Kolmes 2005; Williams et al 2006). Temperature-related mortality of Chinook salmon eggs increases rapidly at temperatures above 56^{o}F (e.g., Myrick and Cech 2004) and the State Board has adopted this standard (for instance, in its water quality regulations for the Sacramento River downstream of Keswick Dam; State Water Quality Control Plan at I-4-10). Steelhead egg mortality also increases rapidly at temperatures above 56^{o}F and some studies indicate that their temperature tolerance may be lower than of Chinook salmon (Richter and Kolmes 2005). Juvenile salmon and steelhead also require cold water to rear and migrate successfully. River temperatures in excess of life-stage specific physiological tolerances for these species may eliminate an entire year class of the affected salmon populations. Partial compliance with a temperature standard (i.e. through only part of a critical period) is equivalent to not meeting the standard at all.

Increasing storage of water behind these dams during the late-fall, winter, and spring increases the volume of cold water (the cold-water pool) that can be released during warm months in order to alleviate temperature stress to salmon and steelhead life-stages present in the rivers just below the reservoirs. Cold water releases from dams during the summer principally benefit:

- winter-run Chinook salmon (eggs, larvae, juveniles),
- spring-run Chinook salmon (mature adults, rearing juveniles),
- and steelhead (eggs, larvae, rearing juveniles, and migrating adults).

Given current hydrological conditions, storage of additional water in upstream reservoirs may, if released appropriately, support greater protection for salmon and steelhead spawning, egg incubation, and larval rearing in the Sacramento River Basin during the summer and fall of 2009.

The Petition does not describe whether and how the water stored upstream as a result of the proposed relaxation will be used to materially benefit salmonid populations in the Sacramento River this year. The petition explicitly states that its main purpose is maintenance of the cold-water pool and protection of salmonid populations and that implementing the TUC will "result in quantifiable benefit to the [state and federal] Projects" [**petition at p. 16]**. Elsewhere in their Petition, USBR and DWR claim that they cannot estimate the impact of their proposed TUC on the cold-water pool. Yet, the Bureau and DWR possess the modeling software, operational experience, and historic data sets necessary to estimate the beneficial effects on temperature and flow of proposed actions to salmon and steelhead below Sacramento River Basin project reservoirs.

Unless the USBR and DWR can meet minimum temperature and flow requirements for some reasonable stretch of river throughout the entire critical spawning, incubation, and rearing period of the various Chinook salmon runs and steelhead, the relaxation of Delta outflow standards will not provide benefits to these species. The questions that I believe are necessary to answer are these:

- What is the range of potential impacts to both cold-water pool volume and associated benefits to Chinook salmon and steelhead populations of the Sacramento River Basin that would result from adoption of the proposed changes in Delta outflow?
- Specifically, can the USBR and DWR demonstrate that without reduced Delta outflow requirements described in the Petition, they could not meet cold-water pool and flow requirements for salmon in 2009?
- If that is the case, can they demonstrate that they will be able to meet cold-water pool and flow requirements for salmon in 2009 if the relaxed Delta outflow standards are adopted?
- Is sufficient protection of upstream salmon habitat contingent on improvement in overall hydrological conditions to a much larger degree than the relaxation can provide, or will the relaxation be sufficient in itself?
- Similarly, if the USBR and DWR *can* meet temperature and flow requirements for Chinook salmon and steelhead in some section of rivers below project reservoirs without the proposed Delta outflow relaxation, then how much more cold-water habitat (how many miles of river in what months) will be provided by the additional storage of water suggested by the proposed TUC?

Without this kind of documentation, it is impossible to assess the benefits of the proposed TUC.

The proposed benefits of the temporary relaxation are speculative unless the USBR and DWR demonstrate that the increase in stored water provided by relaxed Delta outflow standards will provide additional spawning, incubation, and rearing habitat (measured in river miles) throughout the entire spawning season. There is no "partial credit" for providing adequate incubation habitat that does not last the entire incubation period; exceeding the temperature maximum for incubating eggs or rearing juveniles will produce mortality of those fish. If the USBR and DWR project that the additional water stored as a result of this petition can provide for additional upstream habitat for salmonid populations of the Sacramento River basin and if those benefits outweigh the negative effects of reduced Delta outflows (*described above*), then the agencies next need to show how those stored water resources in the Sacramento River Basin will be used for the benefit of Chinook salmon (particularly, the winter and spring-runs) and steelhead in the stretches of river where reservoir releases affect habitat conditions. In addition to maximizing the benefit of cold-water releases this year for spawning, incubating, and rearing salmonids, the projects should also maximize storage for next year (over-winter storage) so as to minimize the likelihood of a cold-water shortage next year.

6) In summary, I find that:

A) The proposed reductions in Delta outflow are highly likely to produce quantifiable and significant reductions in the population of estuarine and migratory species in the Estuary. The Petition neglects, dismisses, and fails to document the very real and potentially large negative impacts of reduced Delta outflows. DWR and USBR do not document or acknowledge these negative effects and understate the duration and magnitude of flow reductions that are request.

B) Petitioner's assertion that the X2 standards are based on a hypothetical relationship between high outflow (low X2) and increased habitat volume for all species is both incorrect and irrelevant. Multiple mechanisms are likely to drive the positive freshwater flow:abundance relationships of different species; even within a single species, populations may respond positively to different mechanisms (food production, transport, protection from predators) that are all related to increased freshwater flow. The paper by Kimmerer et al (2009) demonstrates that positive freshwater flow:habitat volume relationships may explain a large fraction of the population response for two important species (American shad and striped bass) and may play a smaller role in several other estuarine species. Regardless of the causal mechanisms, the State Board's freshwater flow standards (as embodied in X2 requirements) continue to be based in strong, persistent, and widespread relationships between freshwater flow and fish and wildlife species abundance.

D) In contrast to the justification offered by USBR and DWR for relaxing the outflow objectives, there is no stated intention or plan to produce benefits to fish and wildlife populations resulting from the proposed relaxation of the San Joaquin River flow objectives. The proposed reduction in San Joaquin inflows will adversely affect migrating juvenile salmonids and may increase entrainment-related mortality for a number of species at the south Delta export facilities.

E) Increasing export pumping (e.g. to capture runoff from storm events) during the period when Delta water quality objectives are relaxed is likely to produce increased entrainment-related mortality for several at-risk species that live in or migrate through the Delta. The synergistic effects of reduced Delta outflow and entrainment are particularly clear for longfin smelt; similar impacts are likely for winter-run Chinook salmon, spring-run Chinook salmon, Delta smelt, and steelhead – indeed, the recent increase in pumping rates has already produced an increase in entrainment at the South Delta pumps.

F) there may be good biological reasons to reduce releases from CVP and SWP storage facilities in the Sacramento River Basin for the protection of spawning, incubating and rearing salmon later in the season. However, the petition does not document the potential magnitude or specific allocation of those benefits (i.e. to the different populations and life-stages of salmonids), making it impossible to assess the alleged benefits of enhanced upstream storage or to weigh them against the negative impacts of reducing Delta inflows and outflows. A number of questions need to be answered before DWR and USBR can clearly demonstrate that there will be benefits of increased reservoir storage for salmonids in the Sacramento River Basin.

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Attachment A

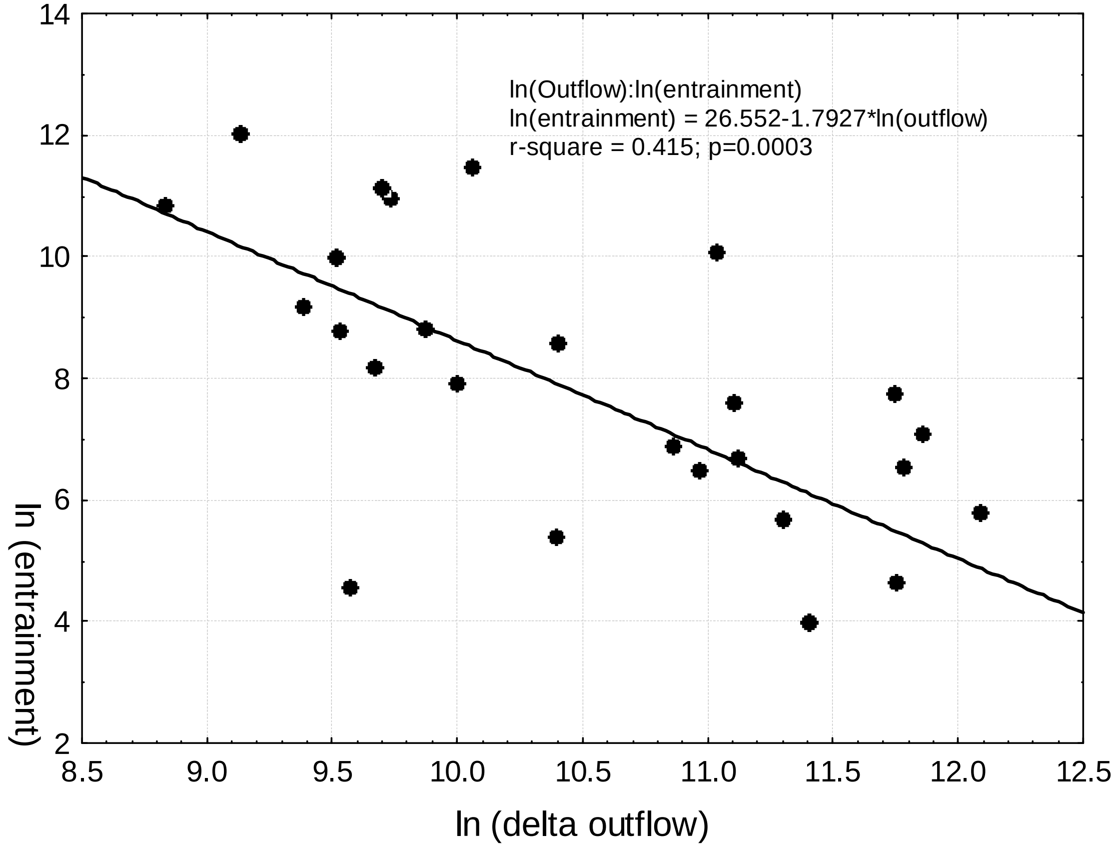

Figure __: Annual combined entrainment of longfin smelt by the State Water Project and federal Central Valley Project in relation to log(average winter Delta outflows). Entrainment estimates do not include fish smaller than ~20mm (i.e. larval longfin smelt) nor do they account for increased mortality experienced by fish as they move towards the South Delta pumping facilities.

Attachment B

CENTRAL VALLEY OPERATIONS OFFICE REPORTS ON CHINOOK SALMON, STEELHEAD, DELTA SMELT, LONGFIN SMELT, AND SPLITTAIL ENTRAINMENT REPORTS; February 2009

CENTRAL VALLEY OPERATIONS OFFICE

DELTA SMELT AND SPLITTAIL

February-09

Note: Bold numbers are not verified by DFC

Preliminary Data - Subject to Change

DATE	Delta Smelt Daily Total SWP	Larval Y or N	Delta Smelt Daily Total CVP	Larval Y or N	Delta Smelt Combined Daily Total	Delta Smelt Combined 14-Day Average	Splittail Daily Total SWP	Splittail Daily Total CVP	Splittail Combined Daily Total	Splittail Combined 14-Day Average	Longfin Daily Total SWP	Larval Y or N	Longfin Daily Total CVP	Larval Y or N	Pumping Daily Total In CFS Banks	Pumping Daily Total In CFS Tracy	Pumping Daily Total In CFS Combined	Pumping Daily Total In Acre Feet Banks	Pumping Daily Total In Acre Feet Tracy	Pumping Daily Total In Acre Feet Combined	Delta Smelt Daily Density SWP	Delta Smelt Daily Density CVP
1-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,017	995	2,013	2,018	1,974	3,992	0.0	0.0
2-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,009	991	1,999	2,001	1,965	3,966	0.0	0.0
3-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,007	995	2,003	1,998	1,974	3,972	0.0	0.0
4-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,011	855	1,866	2,005	1,696	3,701	0.0	0.0
5-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,010	1,003	2,013	2,003	1,990	3,993	0.0	0.0
6-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,044	1,001	2,044	2,070	1,985	4,055	0.0	0.0
7-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		919	1,003	1,922	1,822	1,990	3,812	0.0	0.0
8-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,023	1,001	2,024	2,030	1,985	4,015	0.0	0.0
9-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,027	1,003	2,030	2,037	1,990	4,027	0.0	0.0
10-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,030	1,002	2,032	2,043	1,987	4,030	0.0	0.0
11-Feb-09	**0**		**4**		4	0	**0**	**0**	0	0	**0**		**0**		1,687	1,719	3,407	3,347	3,410	6,757	0.0	1.2
12-Feb-09	**0**		**0**		0	0	**0**	**0**	0	0	**0**		**0**		1,892	2,018	3,910	3,753	4,003	7,756	0.0	0.0
13-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
14-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
15-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
16-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
17-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
18-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
19-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
20-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
21-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
22-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
23-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
24-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
25-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
26-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
27-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
28-Feb-09					0	0			0	0					0	0	0			0	#DIV/0!	#DIV/0!
Total	0		4		4	XXXX	0	0	0	XXXX	0		0		13,676	13,587	27,263	27,127	26,949	54,076	XXXX	XXXX

Delta Smelt Incidental Take Levels

Below Normal Water Year Type

Delta smelt risk assessment matrix (DSRM) Adult level of concern = 892

Re-consultation level for February = 1,700

CENTRAL VALLEY OPERATIONS OFFICE
STEELHEAD REPORT
February-09

Note: Bold numbers are not verified by DFG **Preliminary Data - Subject to Change**

DATE	Steelhead Estimated Salvage								Steelhead Estimated Loss (Incidental Take)								Pumping					
	Daily SWP		Daily CVP		Daily Combined		Season Combined		Daily SWP		Daily CVP		Daily Combined		Season Combined		Daily Total In CFS			Daily Total In Acre Feet		
	Tagged Estimated Salvage	No Tag Estimated Salvage	Tagged Estimated Salvage	No Tag Estimated Salvage	Tagged Estimated Salvage	No Tag Estimated Salvage	Tagged Estimated Salvage	No Tag Estimated Salvage	Tagged Estimated Loss	No Tag Estimated Loss	Tagged Estimated Loss	No Tag Estimated Loss	Tagged Estimated Loss	No Tag Estimated Loss	Tagged Estimated Loss	No Tag Estimated Loss	Banks	Tracy	Combined	Banks	Tracy	Combined
1-Feb-09	0	0	0	0	0	0	9	15	0	0	0	0	0	0	6	10	1,017	995	2,013	2,018	1,974	3,992
2-Feb-09	**0**	**0**	**0**	**0**	0	0	9	15	0	0	0	0	0	0	6	10	1,009	991	1,999	2,001	1,965	3,966
3-Feb-09	**0**	**0**	**0**	**0**	0	0	9	15	0	0	0	0	0	0	6	10	1,007	995	2,003	1,998	1,974	3,972
4-Feb-09	**0**	**0**	**0**	**0**	0	0	9	15	0	0	0	0	0	0	6	10	1,011	855	1,866	2,005	1,696	3,701
5-Feb-09	**0**	**0**	**0**	**0**	0	0	9	15	0	0	0	0	0	0	6	10	1,010	1,003	2,013	2,003	1,990	3,993
6-Feb-09	**0**	**0**	**0**	**0**	0	0	9	15	0	0	0	0	0	0	6	10	1,044	1,001	2,044	2,070	1,985	4,055
7-Feb-09	**0**	**0**	**0**	**0**	0	0	9	15	0	0	0	0	0	0	6	10	919	1,003	1,922	1,822	1,990	3,812
8-Feb-09	**0**	**0**	**0**	**0**	0	0	9	15	0	0	0	0	0	0	6	10	1,023	1,001	2,024	2,030	1,985	4,015
9-Feb-09	**0**	**0**	**0**	**0**	0	0	9	15	0	0	0	0	0	0	6	10	1,027	1,003	2,030	2,037	1,990	4,027
10-Feb-09	**0**	**0**	**0**	**0**	0	0	9	15	0	0	0	0	0	0	6	10	1,030	1,002	2,032	2,043	1,987	4,030
11-Feb-09	**0**	**0**	**4**	**4**	4	4	13	19	0	0	3	3	3	3	9	13	1,687	1,719	3,407	3,347	3,410	6,757
12-Feb-09	**0**	**0**	**0**	**4**	0	4	13	23	0	0	0	3	0	3	9	15	1,892	2,018	3,910	3,753	4,003	7,756
13-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
14-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
15-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
16-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
17-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
18-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
19-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
20-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
21-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
22-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
23-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
24-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
25-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
26-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
27-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
28-Feb-09					0	0	13	23	0	0	0	0	0	0	9	15	0	0	0			0
Total	0	0	4	8	4	8	13	23	0	0	3	5	3	5	9	15	13,676	13,587	27,263	27,127	26,949	54,076

CENTRAL VALLEY OPERATIONS OFFICE
CHINOOK SALMON REPORT
February 2009

Note:Bold numbers are not verified by DFG & DWR **Preliminary Data - Subject to Change**

DATE	Winter Run Chinook Salmon Estimated Loss (Incidental Take)								Spring Run Chinook Salmon Estimated Loss (Incidental Take)								Pumping					
	Daily SWP		Daily CVP		Daily Combined		Season Combined		Daily SWP		Daily CVP		Daily Combined		Season Combined		Daily Total In CFS			Daily Total In Acre Feet		
	Tagged* Estimated Loss	No Tag Estimated Loss	Tagged* Estimated Loss	No Tag Estimated Loss	Tagged* Estimated Loss	No Tag Estimated Loss	Tagged* Estimated Loss	No Tag Estimated Loss	Tagged Estimated Loss	No Tag Estimated Loss	Tagged Estimated Loss	No Tag Estimated Loss	Tagged Estimated Loss	No Tag Estimated Loss	Tagged Estimated Loss	No Tag Estimated Loss	Banks	Tracy	Combined	Banks	Tracy	Combined
1-Feb-09	0	0	0	0	0	0	35	28	0	0	0	0	0	0	0	0	1,017	995	2,013	2,018	1,974	3,992
2-Feb-09	0	0	0	0	0	0	35	28	0	0	0	0	0	0	0	0	1,009	991	1,999	2,001	1,965	3,966
3-Feb-09	0	0	0	0	0	0	35	28	0	0	0	0	0	0	0	0	1,007	995	2,003	1,998	1,974	3,972
4-Feb-09	39	0	0	0	39	0	74	28	0	0	0	0	0	0	0	0	1,011	855	1,866	2,005	1,696	3,701
5-Feb-09	0	0	0	0	0	0	74	28	0	0	0	0	0	0	0	0	1,010	1,003	2,013	2,003	1,990	3,993
6-Feb-09	0	0	0	0	0	0	74	28	0	0	0	0	0	0	0	0	1,044	1,001	2,044	2,070	1,985	4,055
7-Feb-09	0	0	4	0	4	0	78	28	0	0	0	0	0	0	0	0	919	1,003	1,922	1,822	1,990	3,812
8-Feb-09	0	0	0	0	0	0	78	28	0	0	0	0	0	0	0	0	1,023	991	2,015	2,030	1,966	3,996
9-Feb-09	0	0	4	0	4	0	82	28	0	0	0	0	0	0	0	0	1,027	1,003	2,030	2,037	1,990	4,027
10-Feb-09	0	0	0	0	0	0	82	28	0	0	0	0	0	0	0	0	1,030	1,002	2,032	2,043	1,987	4,030
11-Feb-09	0	0	4	0	4	0	86	28	0	0	0	0	0	0	0	0	1,687	1,719	3,407	3,347	3,410	6,757
12-Feb-09	0	0	0	0	0	0	86	28	0	0	0	0	0	0	0	0	1,892	2,018	3,910	3,753	4,003	7,756
13-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
14-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
15-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
16-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
17-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
18-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
19-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
20-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
21-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
22-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
23-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
24-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
25-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
26-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
27-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
28-Feb-09					0	0	86	28					0	0	0	0	0	0	0			0
Total	39	0	12	0	51	0	86	28	0	0	0	0	0	0	0	0	13,676	13,577	27,253	27,127	26,930	54,057

Winter Run Incidental Take Levels (Oct 1 thru May 31)

Spring Run Incidental Take Levels for Season Combined Total (Oct 1 thru Jun 30)

Tagged Yellow Light Level = ??? Season
Tagged Red Light Level = ??? Season
No Tag Yellow Light Level = ??? Season
No Tag Red Light Level = ??? Season

* This number is determined by Winter Run Length only until the tags have been read.
All tags from Winter Run Length Fish have been read and numbers are updated thru 2/28/05.